

IN THE CLAIMS

Claims 1 – 26 (Cancelled)

Claim 27 has been amended as follows:

27. (Currently amended) An implantable medical apparatus for detecting diastolic heart failure (DHF) comprising:

a sensor ~~adapted~~ configured to interact with a heart to obtain information associated with functioning of the heart; and

a DHF determining device supplied with said information that detects a DHF state of the heart from said information by determining, as a DHF parameter, a time duration of a predetermined phase of diastole of the heart and, upon detecting said DHF state, that emits an output signal indicating said DHF state.

28. (Previously presented) An apparatus as claimed in claim 27 wherein said DHF determining device comprises a comparator that compares said time duration with an upper limit value and a lower limit value to obtain a comparison result, said comparison result being indicative of said DHF state.

29. (Previously presented) An apparatus as claimed in claim 27 wherein said DHF determining device comprises a calculating unit that calculates, from said information from said sensor, said time duration, as a time from an occurrence of peak blood flow velocity through the mitral valve of the heart to a time of occurrence of zero blood flow velocity through the mitral valve of the heart.

Claim 30 has been amended as follows:

30. (Currently amended) An apparatus as claimed in claim ~~27-29~~ wherein said calculating unit determines said time duration by extrapolating said mitral blood flow velocity to zero, if an actual occurrence of zero blood flow velocity through the mitral valve does not occur before an atrial contraction of the heart.

Claim 31 has been amended as follows:

31. (Currently amended) An apparatus as claimed in claim ~~27-29~~ wherein said calculating unit extrapolates the blood flow velocity to zero by determining a time derivative of blood flow velocity through the mitral valve shortly after said occurrence of said peak blood flow velocity through the mitral valve.

Claim 32 has been amended as follows:

32. (Currently amended) An apparatus as claimed in claim ~~27-29~~ wherein said sensor senses an IEGM signal from the heart, and wherein said calculating unit calculates the time of occurrence of said peak blood flow velocity through the mitral valve to the time of occurrence of zero blood flow velocity through the mitral valve from said IEGM.

33. (Previously presented) An apparatus as claimed in claim 29 wherein said sensor is an impedance sensor that senses an impedance of the heart, and wherein said calculating unit calculates the time from the occurrence of said peak blood flow velocity through the mitral valve to zero blood flow velocity through the mitral valve from said impedance.

34. (Previously presented) An apparatus as claimed in claim 29 wherein said sensor is a sound sensor that detects a sound signal associated with said functioning of the heart, and wherein said calculating unit calculates the time from

the occurrence of said peak blood flow velocity through the mitral valve to zero blood flow velocity through the mitral valve from said sound signal.

35. (Previously presented) An apparatus as claimed in claim 29 wherein said sensor is an accelerometer that detects an activity signal representing activity of a subject in whom said DHF determining device is implanted, and wherein said calculating unit calculates the time from the occurrence of said peak blood flow velocity through the mitral valve to zero blood flow velocity through the mitral valve from said activity signal.

Claim 36 has been amended as follows:

36. (Currently amended) An apparatus as claimed in claim 27 wherein said DHF determining device comprises a calculating unit that calculates, as said time duration, ~~and~~ an isovolumic relaxation time (IVRT) from said information from said sensor.

37. (Previously presented) An apparatus as claimed in claim 36 wherein said sensor detects an IEGM from the heart, and wherein said calculating unit determines said IVRT from said IEGM.

38. (Previously presented) An apparatus as claimed in claim 36 wherein said sensor is an impedance sensor that measures an impedance of the heart, and wherein said calculating unit calculates said IVRT from said impedance.

39. (Previously presented) An apparatus as claimed in claim 36 wherein said sensor is a sound sensor that detects a sound signal associated with said functioning of the heart, and wherein said calculating unit calculates said IVRT from said sound signal.

40. (Previously presented) An apparatus as claimed in claim 36 wherein said sensor is an accelerometer that detects an activity signal of a patient in whom said DHF determining device is implanted, and wherein said calculating unit calculates said IVRT from said activity signal.

41. (Previously presented) An apparatus as claimed in claim 29 wherein said DHF determining device determines said time duration respectively at predetermined time intervals, thereby obtaining a plurality of time durations, and comprises a memory in which said plurality of time durations are stored.

42. (Previously presented) An apparatus as claimed in claim 29 wherein said DHF determining device determines said time duration respectively at a plurality of predetermined time intervals, and comprises a comparator that compares each of said time durations to an upper limit value to identify a first plurality of time durations above said upper limit value and respective first magnitudes of respective deviations of said first plurality of time durations from said upper limit value, and a second plurality of time durations below said lower limit value and second magnitudes of deviations of said second plurality of time durations from said lower limit value, and comprises a memory in which said first plurality of time durations, said first magnitudes, said second plurality of time durations, and said second magnitudes are stored.

43. (Previously presented) An apparatus as claimed in claim 29 wherein said DHF determining device determines said time duration at a plurality of different times, and determines changes in the respective time durations determined at said different times, and comprises a memory in which said changes are stored.

44. (Previously presented) An apparatus as claimed in claim 29 wherein said DHF determining device comprises a comparator that compares said time duration to an upper limit value and to a lower limit value, and comprises an alerting unit that emits a humanly perceptible alert if a deviation of said time duration from either of said upper limit value or said lower limit value exceeds a predetermined threshold value.

45. (Previously presented) An apparatus as claimed in claim 44 wherein said alerting unit triggers said alert if a length of time that said deviation exceeds said predetermined threshold value exceeds a predetermined length of time.

46. (Previously presented) An apparatus as claimed in claim 29 wherein said DHF determining device determines said time duration at respectively different times and detects a change in said time duration detected at respectively different times, and comprises a comparator that compares said change to a predetermined threshold value, and an alerting unit that emits a humanly perceptible alert if said change exceeds said predetermined threshold value.

Claim 47 has been amended as follows:

47. (Currently amended) An implantable cardiac pacemaker comprising:
a pulse generator that emits stimulation pulses;
an electrode system ~~adapted~~ configured to interact with the heart of a subject
to deliver said stimulation pulses to the heart in a pacing therapy
regimen[[,]];
a sensor ~~adapted~~ configured to interact with a heart to obtain information
associated with functioning of the heart;[[, and]]

a DHF determining device supplied with said information that detects a DHF state of the heart from said information by determining, as a DHF parameter, a time duration of a predetermined phase of diastole of the heart and that emits a detector output representing said DHF parameter; and

a control unit connected to said DHF determining device and to said pulse generator, said control device being supplied with said detector output and controlling said pulse generator to modify said pacing therapy regimen dependent on said DHF parameter.

Claim 48 has been amended as follows:

48. (Currently amended) A method for detecting diastolic heart failure (DHF) comprising:

with a sensor adapted configured to interact with a heart ~~to obtain~~ obtaining information associated with functioning of the heart; and

~~a DHF determining device supplied with said information that detects~~ automatically electronically detecting a DHF state of the heart from said information by determining, as a DHF parameter, a time duration of a predetermined phase of diastole of the heart, and emitting an output signal indicating said DHF state.

Claim 49 has been amended as follows:

49. (Currently amended) A method as claimed in claim 27 ~~wherein~~ 48 comprising determining said DHF state by comparing ~~determining device comprises~~ ~~a comparator that compares~~ said time duration with an upper limit value and a lower

limit value to obtain a comparison result, said comparison result being indicative of said DHF state.

Claim 50 has been amended as follows:

50. (Currently amended) A method as claimed in claim 48 comprising 27 ~~wherein said DHF determining device comprises a calculating unit that calculates,~~ from said information from said sensor, said time duration, as a time from an occurrence of peak blood flow velocity through the mitral valve of the heart to a time of occurrence of zero blood flow velocity through the mitral valve of the heart.

Claim 51 has been amended as follows:

51. (Currently amended) A method as claimed in claim 50 comprising 27 ~~wherein said~~ calculating unit determines said time duration by extrapolating said mitral blood flow velocity to zero, if an actual occurrence of zero blood flow velocity through the mitral valve does not occur before an atrial contraction of the heart.

Claim 52 has been amended as follows:

52. (Currently amended) A method as claimed in claim 50 comprising 27 ~~wherein said~~ calculating said time duration by extrapolating ~~unit extrapolates~~ the blood flow velocity to zero by determining a time derivative of blood flow velocity through the mitral valve shortly after said occurrence of said peak blood flow velocity through the mitral valve.

Claim 53 has been amended as follows:

53. (Currently amended) A method as claimed in claim 50 comprising, with 27 ~~wherein~~ said sensor, sensing senses an IEGM signal from the heart, and ~~wherein~~ said calculating unit ~~calculates~~ the time of occurrence of said peak blood flow

velocity through the mitral valve to the time of occurrence of zero blood flow velocity through the mitral valve from said IEGM.

Claim 54 has been amended as follows:

54. (Currently amended) A method as claimed in claim 50 comprising, with ~~29 wherein said sensor, sensing is an impedance sensor that senses an impedance~~ of the heart, and ~~wherein said calculating unit calculates the time from the~~ occurrence of said peak blood flow velocity through the mitral valve to zero blood flow velocity through the mitral valve from said impedance.

Claim 55 has been amended as follows:

55. (Currently amended) A method as claimed in claim 50 comprising, with ~~29 wherein said sensor, detecting is a sound sensor that detects a sound signal~~ associated with said functioning of the heart, and ~~wherein said calculating unit~~ ~~calculates the time from the occurrence of said peak blood flow velocity through the~~ mitral valve to zero blood flow velocity through the mitral valve from said sound signal.

Claim 56 has been amended as follows:

56. (Currently amended) A method as claimed in claim 50 comprising, with ~~29 wherein said sensor, detecting is an accelerometer that detects an activity signal~~ representing activity of a subject in whom said sensor DHF ~~determining device~~ is implanted, and ~~wherein said calculating unit calculates the time from the occurrence~~ of said peak blood flow velocity through the mitral valve to zero blood flow velocity through the mitral valve from said activity signal.

Claim 57 has been amended as follows:

57. (Currently amended) A method as claimed in claim 50 comprising 27 ~~wherein said DHF determining device comprises a calculating unit that calculates, as~~ said time duration, ~~and~~ an isovolumic relaxation time (IVRT) from said information from said sensor.

Claim 58 has been amended as follows:

58. (Currently amended) A method as claimed in claim 57 comprising, with ~~36 wherein said sensor, detecting~~ detects an IEGM from the heart, and ~~wherein said calculating unit determines~~ said IVRT from said IEGM.

Claim 59 has been amended as follows:

59. (Currently amended) A method as claimed in claim 57 comprising, with ~~36 wherein said sensor, measuring is an impedance sensor that measures an~~ impedance of the heart, and wherein said calculating unit calculates said IVRT from said impedance.

Claim 60 has been amended as follows:

60. (Currently amended) A method as claimed in claim 57 comprising, with ~~36 wherein said sensor, detecting is a sound sensor that detects a sound signal~~ associated with said functioning of the heart, and ~~wherein said calculating unit~~ calculates said IVRT from said sound signal.

Claim 61 has been amended as follows:

61. (Currently amended) A method as claimed in claim 57 comprising, with ~~36 wherein said sensor, detecting is an accelerometer that detects an activity signal~~ of a patient in whom said ~~DHF determining device~~ sensor is implanted, and ~~wherein said calculating unit calculates~~ said IVRT from said activity signal.

Claim 62 has been amended as follows:

62. (Currently amended) A method as claimed in claim 48 comprising determining ~~29 wherein said DHF determining device determines~~ said time duration respectively at predetermined time intervals, thereby obtaining a plurality of time durations, and ~~comprises a memory in which~~ electronically storing said plurality of time durations in a memory ~~are stored~~.

Claim 63 has been amended as follows:

63. (Currently amended) An implantable cardiac pacemaker apparatus as claimed in claim 47 ~~48~~ wherein said DHF determining device determines said time duration at a plurality of different times, and determines changes in the respective time durations determined at said different times, and ~~comprises~~ wherein said implantable cardiac pacemaker comprises a memory in which said changes are stored.